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Entomological Circular

RESULTS FROM SPRAYING

IN

NOVA SCOTIA

BY

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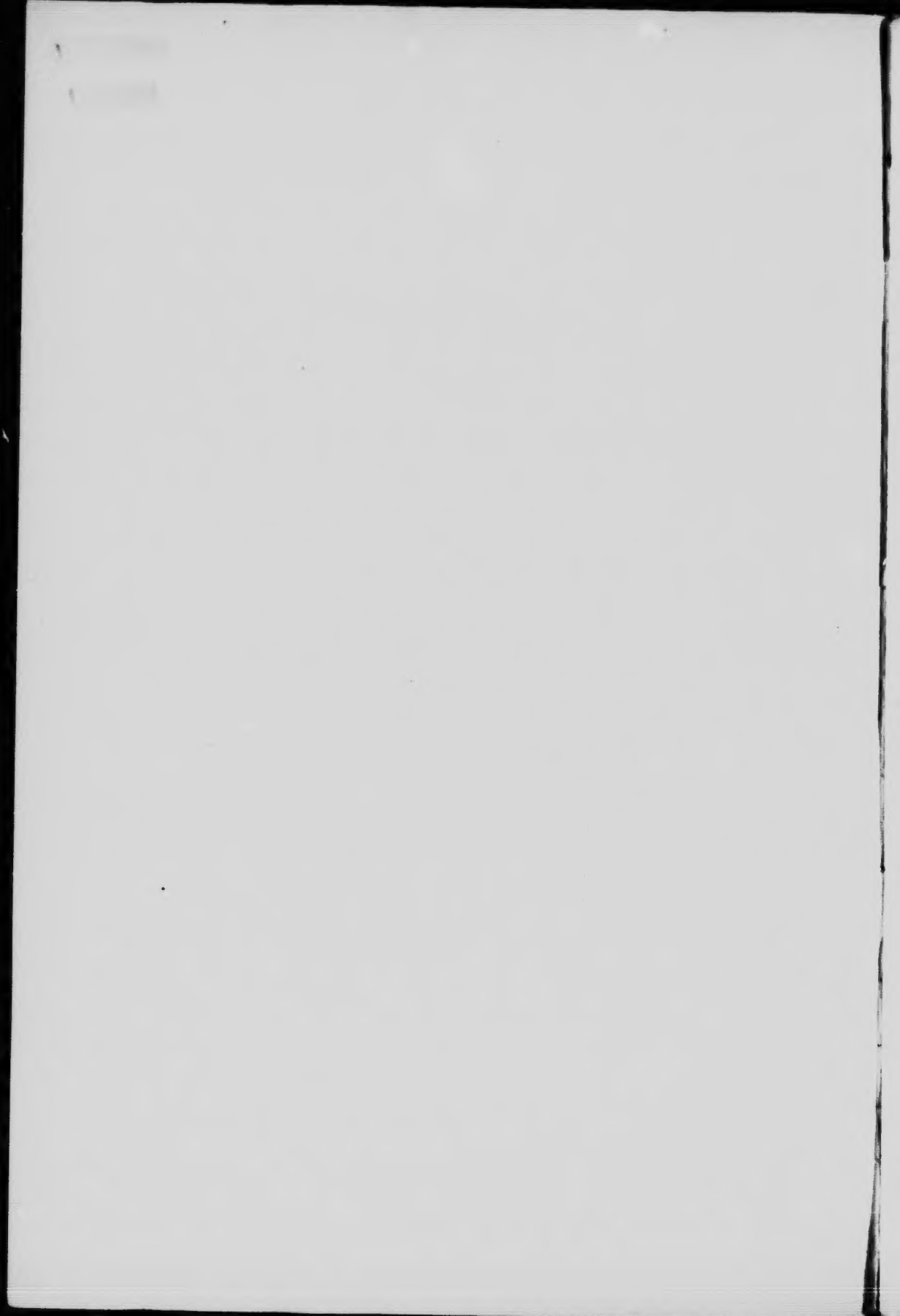
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OTTAWA, January 25, 1916.

To the Honourable
The Minister of Agriculture,
Ottawa.

SIR,—I have the honour to submit for your approval Entomological Circular No. 7, entitled "Results from Spraying in Nova Scotia," which has been prepared by Mr. George E. Sanders, Field Officer in charge of the Entomological Laboratory at Annapolis Royal, N.S., and Prof. W. H. Brittain, Provincial Entomologist for Nova Scotia.

Since 1911 Mr. Sanders has been investigating the control of the bud-moths and green fruit worms of apple and Prof. Brittain, since his appointment in 1913, has co-operated in the investigation of fruit insects by studying the sucking insects, and he has also been responsible for the work on the control of the plant diseases such as apple scab. As a result of this excellent co-operative work splendid results have been obtained in experimental and demonstration orchards. This has increased the number of those who spray and has improved spraying methods.

With a view to convincing growers whose methods require improvement and those who may feel that our experimental results may perhaps have a more rosy hue than could be obtained by the practical fruit-grower, Messrs Sanders and Brittain have also secured the results obtained by practical growers in the Annapolis Valley and have analysed these in such a manner as to demonstrate most clearly from every point of view, both practical and economical, that proper spraying pays, and in fact is essential to profitable fruit growing, thus supporting the conclusions to which their investigations have led them.

A careful perusal of this Circular and the putting into practice of the principles that govern correct spraying will mean the production of more fruit of better quality with increased profits to the grower and greater satisfaction to the consumer.

I have the honour to be, Sir,
Your obedient servant,

C. GORDON HEWITT,
Dominion Entomologist.

RESULTS FROM SPRAYING IN NOVA SCOTIA

By G. E. SANDERS AND W. H. BRITAIN.

In this publication we wish to draw the reader's attention to actual results obtained by owners spraying for profit in their own orchards in the Annapolis Valley, Nova Scotia. We know that thorough spraying increases the quality of the fruit by preventing insect injury and protecting it from fungus diseases. It also increases the quantity even more than the quality by preventing insect injury to the blossoms and by protecting the stems of the blossoms and the leaves from apple scab. Well sprayed leaves are retained until late in the fall, thus enabling larger and stronger fruit buds to be formed and a consequent stronger bloom on the sprayed trees in the following year. Another benefit not often realized to its full extent is the economy with which good, clean sprayed lots of fruit may be handled, and we have included in this publication a statement showing the economy with which one lot of good apples was handled this year.

The following four articles have been selected from the best that have been published during the season,—the first showing *Increase in Quality* due to spraying, as well as the large profits from spraying received by those who sprayed thoroughly, and the very small profits received by those who only half sprayed. Our second article deals chiefly with *Increase in Quantity* due to continued spraying, but shows the increase in quality to a certain extent. Our third article shows the *Economy in Handling Clean Fruit* as well as the cost of spraying and the excellent results obtained by thorough spraying in 1915, when few unsprayed orchards gave over 5 per cent. No. 1 and 2 Gravensteins. Our fourth article gives the *Actual Profits from Spraying*, and as these results are given in terms of dollars and cents, they will appeal to many to whom percentages do not appeal. The spray calendar published herewith is the result of several years investigation of spraying problems by the authors in the Annapolis Valley, and is the best advice that we can give at the present time on spraying.

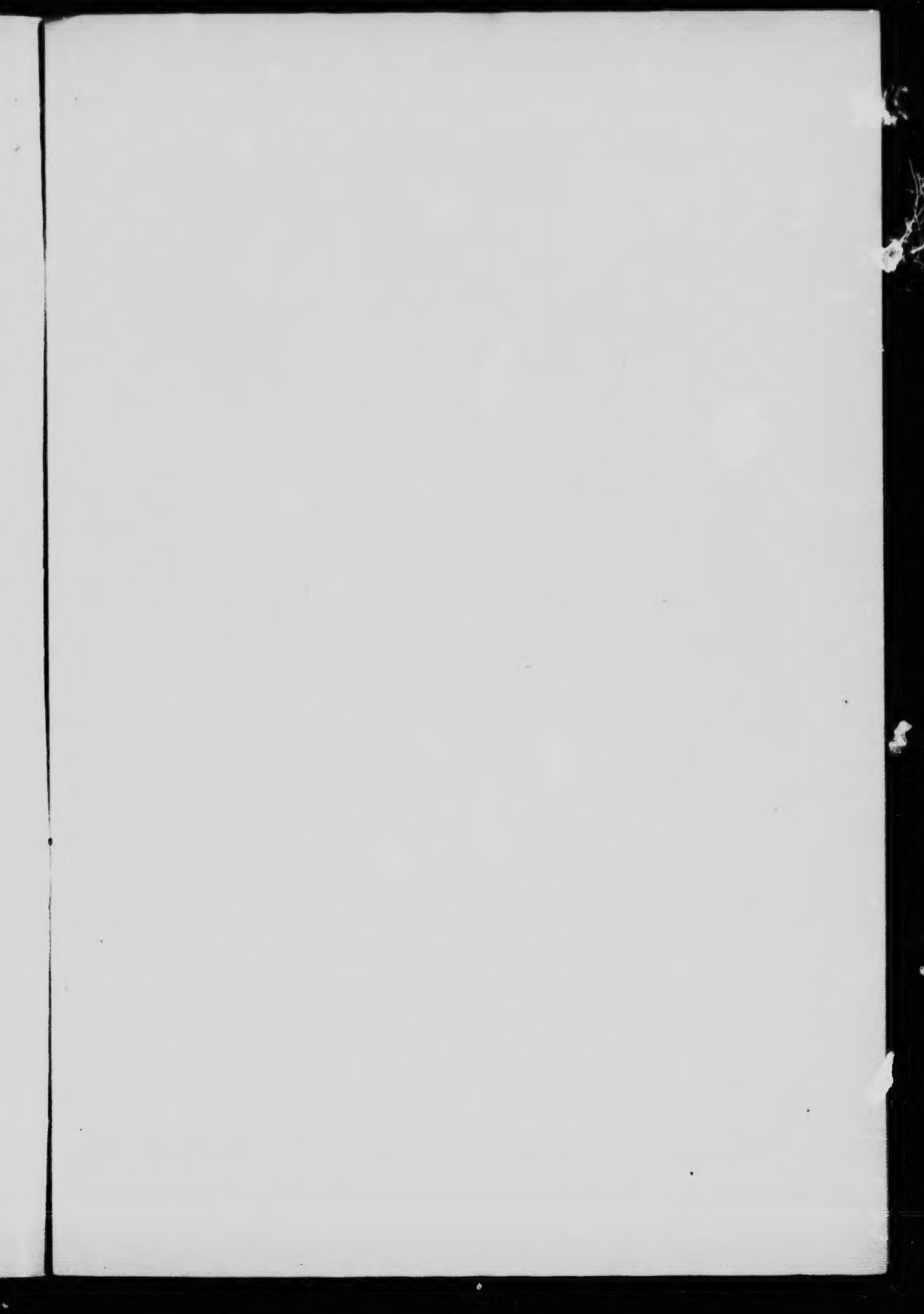
I. INCREASE IN QUALITY OF APPLES DUE TO SPRAYING.

The following "pack out" sheet is similar to those now in use throughout the Annapolis Valley, showing number of sprays applied, character of spraying, kind of nozzles used and character of orchard with the percentage of No. 1's and 2's packed out, and clear profits from same after deducting cost of spraying.

PACK OUT OF GRAVENSTEINS, ROUND HILL FRUIT COMPANY.
SEASON OF 1915.

Owners No.	Percentage Nos. 1 & 2.	*Sprays used 1, 2, 3, 4, 5.	Character of Spraying, etc.	Profit per barrel over cost of spraying and returns from best unsprayed lot.	Nozzle used.	Character of trees.	Spacing of trees.	Exposure of Orchard.
1	68	1, 2, 3, 4, 5	Fruit thinned.	50	Drive.	Thick	Close.	Exposed
2	62	1, 2, 3, 4, 5		41	Drive.	Thick	Close.	Exposed
3	53	1, 2, 3, 4, 5		32	Mist.	Thick	Close.	Exposed
4	51	1, 2, 3, 4, 5		30	Mist.	Thick	Open.	Exposed
5	50	1, 2, 3, 4		29	Drive.	Thick	Open.	Sheltered.
6	47	1, 2, 3, 4	Not quite enough spray used. Low pressure; trouble with pump. Three days late with each spray.	25	Mist.	Open.	Close.	Sheltered.
7	41	1, 2, 3, 4		20	Drive.	Open.	Open.	Exposed.
8	40	1, 2, 3, 4		15	Mist.	Open.	Open.	Exposed.
9	40	1, 2, 3, 4		18	Drive.	Open.	Open.	Exposed.
10	37	2, 3, 4		14	Mist & Drive.	Thick	Open.	Sheltered.
11	35	2, 3, 4	Trouble with pump. Not sprayed previous year. Too late with spray 3.	12	Drive.	Thick	Open.	Sheltered.
12	33	2, 3, 4		9	Mist.	Thick	Close.	Sheltered.
13	29	2, 3, 4		3	Drive.	Thick	Close.	Exposed.
14	26	2, 3, 4		1	Mist.	Thick	Open.	Exposed.
15	25	2, 3		1	Mist.	Thick	Open.	Exposed.
16	23	2, 3	None.	1	Drive.	Thick	Open.	Exposed.
17	22	3		0	Mist 2, Drive 3	Thick	Open.	Exposed.
18	20	None.					Open.	Exposed.
19	16	2, 3					Open.	Exposed.
20	6	None.					Close.	Sheltered.

* Power outfits used in every case where spray was applied.



Spray Calendar for Nova Scotia

W. H. BRITTAIN
Agricultural College
TRURO, N. S.



FIRST SPRAY



SECOND SPRAY

FIRST SPRAY

Time:—When leaves about blossom clusters are showing green. For
Material:—Lime Sulphur 1.009 sp. gr., or 3 gals. commercial strength
Application:—Drench thoroughly at 200 lbs. pressure, using a drive nozzle.
Pests Destroyed:—Apple Scab, Budmoth, Brown-tail Moth, Cankerworm, etc.

SECOND SPRAY

Time:—When blossom buds are showing pink at tips. For Cankerworm
Material:—Lime, Sulphur, 1.008 sp. gr., or about $2\frac{3}{4}$ gals. to 100 of water
Application:—Drench thoroughly at 200 lbs. pressure, using a drive nozzle.
Pests Destroyed:—Apple Scab, Budmoth, Brown-tail Moth, Cankerworm, Blackleaf 40, 1 pint to 100 gals., making certain that every inch of trees must be banded before spraying, with tree tanglefoot and

THIRD SPRAY

Time:—When blossoms fall.
Material:—Lime Sulphur, 1.007 sp. gr., or about $2\frac{1}{2}$ gals. to 100 of water
Application:—Use 200 lbs. pressure and a calyx nozzle.
Pests Destroyed:—Apple Scab, Codling Moth, Fruit Worms, Budmoth, etc. from previous sprays.

FOURTH SPRAY

Time:—Ten days or two weeks after the third spray.
Material:—Lime Sulphur slightly weaker than in third spray, and
Application:—Use 200 lbs. pressure and a calyx nozzle.
Pests Destroyed:—Apple Scab, Fruit Worms, Codling Moth, Tussock feeding Brown-tail Moth Caterpillars.

FIFTH SPRAY

In very wet seasons a fifth spray may be necessary to control APPLE SCAB application as the fourth spray. When Tussock Moths or Brown-tail Moths are present.

COPIES OF THIS CALENDAR MAY BE OBTAINED ON APPLICATION

UP FOR REFERENCE

Scotia Apple Orchards for 1916

G. E. SANDERS
Dominion Entomological Laboratory
ANNAPOLIS ROYAL, N. S.



THIRD SPRAY



FOURTH SPRAY

green. For Canker Worm defer this spray for a few days.
ial strength to 100 of water, adding lead arsenate 5 lbs. to 100 gals.
g a drive nozzle.

th, Canker Worm, Tent Caterpillar, etc. If Aphids are present, add Blackleaf 40, 1 pint to 100

or Canker Worm apply slightly earlier; for Green Apple Bug, leave until just before blossoms open.
to 100 of water, adding lead arsenate, 5 lbs. to 100 gals.
ing a drive nozzle.

th, Canker Worm, Fruit Worms, etc. If Green Aphis, or Green Apple Bug are present, add
t every insect is covered with the spray. For very severe infestations of Green Apple Bug, the
glefoot and kept clean cultivated until July 7th.

to 100 of water, adding lead arsenate 5 lbs. to 100 gals.

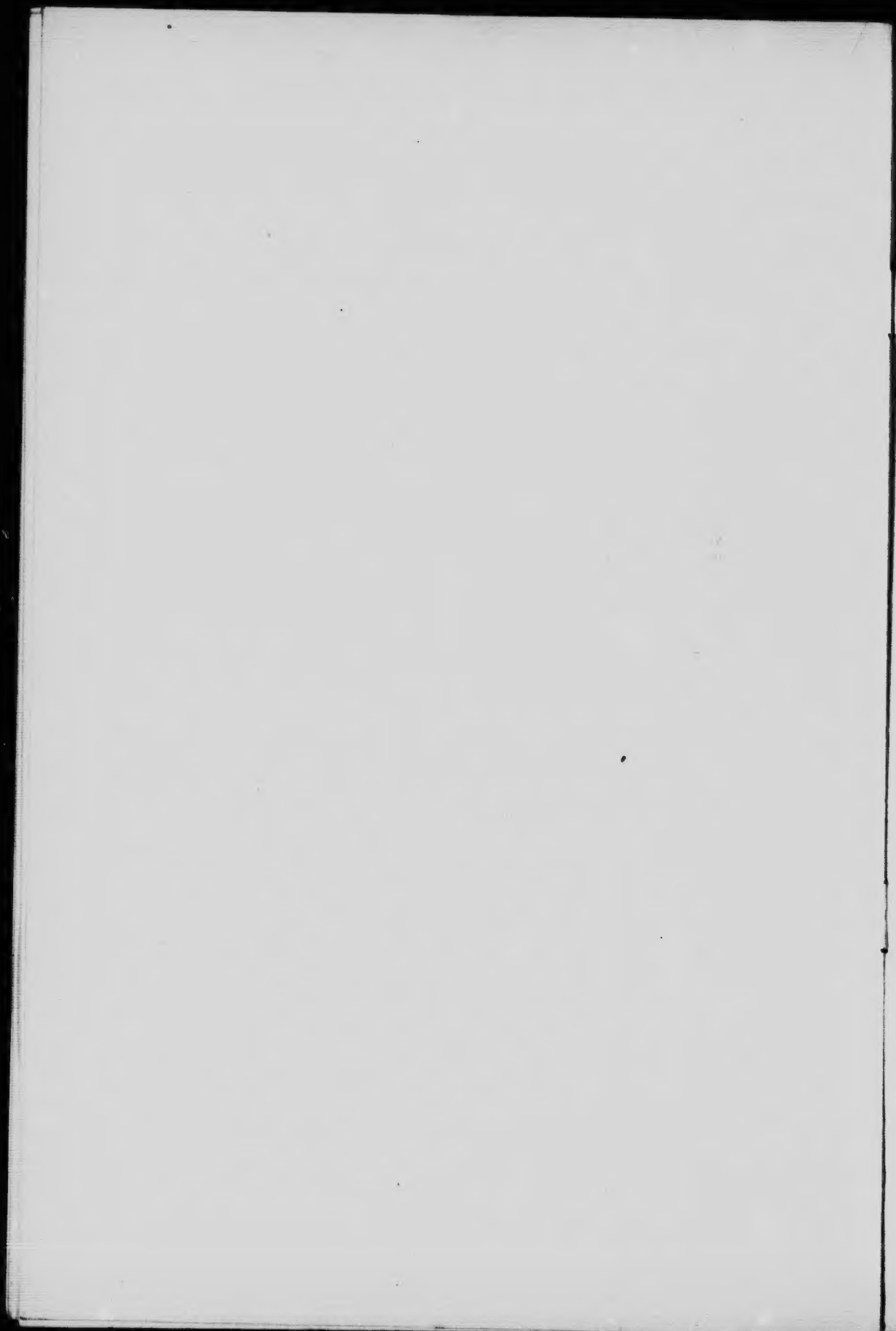
ms, Budmoth, etc If Green Apple Bug is present, add Blackleaf 40, using a drive nozzle as in

spray, adding lead arsenate, 5 lbs. to 100 gals

th, Tussock Moth, Fall Webworm, Red Humped Caterpillar, Yellow Necked Caterpillar, fall

APPLE SCAB. This is applied 10 days to 2 weeks after the fourth and is the same in material and
hs or Brown-tails are present in injurious numbers, the application of this spray is recommended

APPLICATION TO EITHER OF THE ABOVE ADDRESSES.



In the table, Spray 1 refers to that applied when the leaves were the size of a ten cent piece, Spray 2 immediately before the blossoms, Spray 3 immediately after the blossoms, and Spray 4 and 5 ten and twenty days after.

The two highest lots, it will be noticed, were sprayed twice before and three times after the blossoms, with a Drive nozzle in both cases. The next two lots were sprayed once before and three times after the blossoms, the four lots receiving the fifth spray coming at the top of the list—showing up the importance of the fifth spray in 1915. Of the three lots sprayed twice before and twice after the blossoms, the one sprayed with the Drive nozzle leads; and in the next lot to it the fruit was thinned on the trees. Of the lots sprayed once before and twice after the blossoms, the two top ones were sprayed with a Drive nozzle. Others of these lots were sprayed with the Drive nozzle, but in each case there was some defect in time or thoroughness of application, which modified the results. The lots at the bottom of the list speak for themselves and show that one or two sprays—and those perhaps not thoroughly applied—are very little better than no spray in giving quality to the fruit, although Spray 2 and 3 will give enough benefit in insect control to increase the crop by about 80 per cent.

The best sprayed lot averaged \$2.08 per barrel through the Fruit Company, while the best unsprayed lot, No. 18, averaged \$1.43 per barrel through the same company. The best lot was grown in a very close planted, thick orchard, while lot No. 18, the best unsprayed lot, was grown on open, scattered trees, giving it every advantage.

It cost a trifle less than 15 cents per barrel to spray five times the best lot which packed out 68 per cent. Nos. 1 and 2; and from this and other evidence it is apparent that the average cost of spraying once for one barrel of apples this year, at the price at which spray material was purchased through the Fruit Companies, was about 3 cents per barrel.

In the column marked "Profit per barrel over cost of spray", No. 18, the best unsprayed lot of Gravensteins seen this year, was used as a basis. The returns averaged \$1.43 per barrel. In the remainder of the column we have reckoned up the average selling price of each lot on company prices, and have subtracted the cost of spraying and the price obtained for lot No. 18, the best unsprayed lot, and the remainder stands as clear profit attributable only to spraying. This profit does not take into consideration the increased quantity of fruit, which amounts to some 80 per cent., but the increased quality only. Examination of this column shows that even though the cost of spraying has been all charged against quality, the profit from quality is still greatest where the most spray material was used, and least where the least spray was used. Only one exception is found to this—that in lot 8 and 9, which goes to show that three sprays with a Drive nozzle bring the grower more than his neighbour who applies four sprays with a Mist nozzle. In lots 14, 16, 17 and 19 there are glaring factors which show why good results were not obtained. This profits column is decidedly interesting and shows that if a man desires to secure profits he must spray thoroughly. Those who half spray, such as Nos. 13, 14, 15, 16, 17 and 19, do not get the most profitable returns.

A sheet similar to this, but with the owners' names attached, is posted in the Round Hill warehouse, following the plan of last year. This plan has resulted in the Round Hill Company's lot of fruit being one of the best lots in the Valley this season. It gives each man a chance to compare his own with his neighbour's spraying and his actual results, for, after all, the packing table is where we get the final impartial record of the results of our work. The posting of the sheets of the Gravenstein pack-out in every warehouse will, without doubt, instil a competitive spirit into the spraying of next year, and cause more thorough spraying to be done. We would heartily recommend the general adoption of such a plan.

II. INCREASE IN QUANTITY OF APPLES DUE TO CONTINUED SPRAYING.

THE YIELD FROM ONE SPRAYED AND ONE UNSPRAYED ORCHARD DURING THE YEARS 1911, 1912, 1913 AND 1914.

The preceding article shows very well what many people realize, namely, the increase in the quality of fruit due to spraying; but very few realize the enormous increase in *quantity* due to spraying. We have demonstrated in our insect control work that the set of fruit may be increased by 80 per cent, due to the control of three of our most common insects, the budmoths, the fruit worms and the codling moth. The Plant Pathologists and the season of 1913 have demonstrated the enormous increase in set which may come from controlling apple scab, or blackspot, before the blossoms open, by preventing it from infecting the stems of the blossoms and ruining the set. We are just beginning to realize the effect of spraying in causing the leaves to remain healthy during the latter part of the summer and fall, and to remain on the trees much later in the season than those of unsprayed trees, so causing, no doubt, stronger and more healthy fruit buds to be formed and a stronger and more vigorous bloom and set of fruit the following spring.

In selecting orchards to demonstrate this point, we went to the Round Hill Fruit Company and chose one orchard which has been well sprayed since 1909 and one which had never been sprayed until 1915. These orchards were selected on knowledge of their past record in spraying, and no other figures were examined, although there may be many orchards which demonstrate the point even better.

The year 1911 was the year of the big crop; it is also remembered as the year when there was absolutely no blackspot on the apples in Nova Scotia. In that year practically every apple tree in the Annapolis Valley had a full crop of clean fruit. The value of spraying was at its minimum in that year. It could not have increased the quantity nor quality by controlling fungous diseases since none were present; and insect injury, while present, passed almost unnoticed on account of the enormous quantity of apples. We are approximately correct in estimating that both sprayed and unsprayed orchards had a full 100 per cent. crop in 1911.

The following tables show the number of barrels packed out from the sprayed and the unsprayed orchard, as well as the percentage of the 1911 crop, obtained in 1912, 1913, 1914.

NONPAREILS.

Year.	UNSPRAYED ORCHARD.		SPRAYED ORCHARD.	
	Actual Crop.	Percentage of 1911 Crop.	Actual Crop.	Percentage of 1911 Crop.
1911.....	197.25	100	162.75	100
1912.....	64.5	32.5	69.5	42.7
1913.....	41	20.7	309	189.8
1914.....	76.75	38.8	167.5	102.9

We find by totalling the percentage of 1911 crop column that during the years 1912-13-14, the unsprayed orchard averaged 30.6 per cent. of the crop of 1911. While the sprayed orchard during the same years averaged 111.8 per cent. of its 1911 crop, or, in other words, the sprayed orchard averaged comparatively over three and one-half times as many Nonpareils as the unsprayed during the three years.

GRAVENSTEINS.

Year.	UNSPRAYED ORCHARD.		SPRAYED ORCHARD.	
	Actual Crop.	Percentage of 1911 Crop.	Actual Crop.	Percentage of 1911 Crop.
1911.....	57	100	159	100
1912.....	13	22.8	90.5	62.5
1913.....	None	None.	110.75	69.6
1914.....	19	33.3	344.5	216.1

By totalling the percentage column of Gravensteins we find that during the years 1912-13-14, the unsprayed orchard averaged 18.7 per cent. of its 1911 crop, while the sprayed orchard during the same years averaged 116 per cent. of its 1911 crop; or, in other words, the sprayed Gravenstein orchard averaged comparatively over six times as many apples as the unsprayed during the same three years.

Looking at the figures in another light, the man who sprayed increased his crop of Nonpareils by 265 per cent. and increased his crop of Gravensteins by 520 per cent. by his spraying.

We have not considered the difference in quality of fruit in the two orchards, but it is enough to say that the unsprayed orchard packed out 34 per cent. No. 1's and 2's, in Gravensteins in 1914, while the sprayed orchard packed out a fraction over 90 per cent. No. 1 and 2, the same year.

When we know that the spraying costs about fifteen cents per barrel of apples picked, we can realize that a man cannot afford not to spray, that he cannot invest any money in his orchard, or in fact in anything else, that will pay the profits that the money invested in spraying will pay. A return of 520 per cent. more Gravensteins, and in 1914, 56 per cent. more No. 1's and 2's among them, is the advantage the man who sprayed, obtained over his neighbour who did not spray, at a cost of about fifteen cents per barrel.

III. ECONOMY IN HANDLING CLEAN FRUIT.

A RECORD IN GRAVENSTEINS.

In reckoning the value of spraying Gravensteins in 1915, when 15 cents worth of spray material made barrels of apples worth \$3, which would otherwise have been worth \$1.50, besides producing from 50 to 80 per cent. more of them on the trees, one should also take into consideration the economy with which this clean fruit can be handled. In this regard Mr. Frank Fowler of Bridgetown has set a record which will be hard to equal.

Mr. Fowler had a total crop of about 1,200 barrels. He sprayed four times with a power outfit, using calyx nozzles. His spraying material cost him \$35, his labour to apply the spray cost \$60. He reckons a depreciation on his spray outfit of \$40 and \$5 for gasoline and oil, making a total of \$140 to cover cost of spraying his orchard, or a cost of less than 11 $\frac{3}{4}$ cents per barrel of picked fruit.

He has picked and packed his Gravensteins and has reckoned up the number of each grade. Out of the first 179 $\frac{1}{2}$ barrels taken to the warehouse he packed out 149 barrels of No. 1's, 21 barrels of No. 2's, 8 barrels of No. 3's and had 1 $\frac{1}{2}$ barrels of culls left over. Or 83 per cent. No. 1, 11.7 per cent. No. 2, 4.4 per cent. No. 3 and 0.8 per cent. culls.

An unsprayed orchard within one-quarter of a mile of this one was examined and out of some 30 barrels of Gravensteins not a single barrel of No. 1's or No. 2's was packed. All were No. 3's or culls.

These figures, coupled with the fact that Mr. Fowler had a full crop of apples in 1915, following a series of good crops, do not show all of the value from his spraying. In picking, packing and loading on the car, of the 178 barrels packed out in his first shipment, Mr. Fowler employed 90 hours of extra labour, and, in addition, he and his regular man worked 1 $\frac{1}{2}$ days each, making a total of 14 days labour, which on an average cost him \$1.50 per day, or a total of about \$21, including wages to himself, making the cost of picking, packing and loading on the car come at a trifle less than 12 cents per barrel.

This shows how cheaply good crops of good stock, the results of thorough spraying, can be handled, and when a person is figuring his returns from spraying he should always reckon how much more cheaply the clean apples can be handled.

IV. PROFITS IN SPRAYING.

Anyone who has sprayed his orchard, even fairly well, knows that the health of his trees is improved thereby, that the leaves are larger, greener and remain longer on the trees, thus enabling them to mature plump, vigorous blossom buds for the next year's crop. Everyone that has sprayed his orchard thoroughly is well aware that he can grow a better, cleaner crop of apples by so doing. Every observing fruit-grower has doubtless noticed that by adequate spraying the size of his crop is materially and often enormously increased.

It is doubtful, however, if even the most enthusiastic advocates of spraying have an accurate idea of the actual financial returns they may expect from following this practice. To secure definite figures as to costs and profits from spraying we determined to undertake an experiment along these lines under actual orchard conditions. The orchard selected, consisted of about 80 mature trees, one-half Kings and one-half Golden Russets. Owing to neglect these trees had not borne a crop for some five or six years.

The sprays given were those ordinarily applied in good orchard practice, namely: when the leaf buds were showing green, when the blossom petals were showing pink, just after the blossoms fell and when the young fruits were about the size of acorns, lime sulphur being the fungicide and arsenate of lead the insecticide used. No effort was made to do the work with more than ordinary care, the aim being to give the orchard the same treatment that the average careful fruit-grower gives. All the orchard was sprayed, excepting 10 Golden Russets and 9 King trees, which were left as a check. Both plots were treated exactly alike in other respects. The fruit from the unsprayed trees was picked separately and compared with that from an equal number of sprayed trees.

Before the end of the growing season the results were apparent to the most casual observer. The leaves on the unsprayed trees were smaller and lighter in colour, and fell considerably before those of the sprayed trees. Further, it was

very apparent that the sprayed trees would give a good crop of fairly clean fruit, while the unsprayed trees would give a poor crop, with a higher percentage of injury from apple scab, budmoth, green fruit-worms and codling moth. These conclusions were confirmed by actual counts from the picked apples as shown in the following table:—

PERCENTAGE OF APPLE SCAB AND INSECT INJURY ON SPRAYED AND UNSPRAYED TREES.*

No. of trees.	Variety.	Treatment.	PERCENTAGE OF INJURIES.			
			Apple Scab.	Budmoth.	Green Fruit-worm.	Codling Moth.
10	Golden Russet.....	Sprayed 4 times.....	6.5	2.7	2	0
10	" ".....	Unsprayed.....	80.7	0.5	5.7	1
9	Kings.....	Sprayed 4 times.....	7	4.6	4.8	0.4
9	".....	Unsprayed.....	91.8	3.8	6.8	3

* Figures secured from counting 1,000 apples from each plot.

The foregoing table does not, however, give us any idea of the great increase in yield of fruit obtained by spraying, which is by far the greatest benefit derived. This fact is brought out by the following table:—

RESULTS OF SPRAYING AND PRICE RECEIVED FOR CROP FROM SPRAYED AND UNSPRAYED PLOTS.

No. of trees.	Variety.	Treatment.	No. of BARRELS PICKED.			Culls (in bus.)	Total price received.
			No. 1.	No. 2.	No. 3.		
							\$ cts.
10	Golden Russets.....	Sprayed 4 times.....	7	3	2	4	24 60
10	Golden Russets.....	Unsprayed.....	1	1	2	2	6 95
9	Kings.....	Sprayed 4 times.....	21	3	2	3	56 05
9	Kings.....	Unsprayed.....	2	1	4	4	11 50

These figures show strikingly the folly of attempting to grow fruit commercially without spraying. In the case of the Golden Russets, the number of No. 1's was increased seven times. In the case of the Kings the gain is much greater, namely, the No. 1's were increased ten times and a greater net profit per acre.

Further discussion of the above figures is unnecessary as the inference is sufficiently obvious. It is evident that there is nothing that a fruit grower can do to his trees that will yield him such a handsome return as careful and timely spraying. The foregoing figures are only the results from one season, but it is our intention to continue the work over a series of years so that accurate averages can be secured.

We are indebted to Mr. Fred Johnston, of Bridgetown, by whom the spraying was done.